

Product Planning & Development of Y-Type Strainer Used In Thermal Power Plant and Process Plant

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Abstract: *The relevance of product innovations and new product development for the Competitive performance of firms and for the long-term economic growth is a known and recognized topic. In the context of the power plant & process industry, process and product innovations are usually the result of cross-discipline ideas, involving, for instance, biology, chemistry, technology, engineering, nutrition and law. This paper presents a quantifying and reordering method for new product development based on the concurrent engineering concept. We can realize deeply the inner hierarchy workings of concurrent engineering in the new product development process. The purpose of this paper is to develop a dynamic planning method that is innovative, efficient and flexible for new product development by using the concurrent design concept. It ultimately helpful to designers and managers to grasp the interactive information flow between each of the activity factors for planning an optimum design process in new product development. One case study is employed to illustrate this method and the results validate that it can reduce the iterations of design process and shorten the product development time with cost effectiveness.*

Keywords: *Concept selection process, new product development, concurrent engineering process, Material selection, pressure drop calculation.*

I. INTRODUCTION

This paper explain the examination of the common factors of new product planning, design & development i.e. Y- type strainer. It also states about the process involved for concept selection manufacturing & establishes criteria for new product success, the market research tools available for integrating the user/customer needs into the innovative process. The examination of these topics results in the development of an enhanced innovative process model.

Development of new products is extremely essential for the success and smooth running of every industry. There is ample scope of cost saving in various products of every industry. Planning & development of a new product also involved success or failure of systems associated with it. Here we are going to analyze all aspect with respect to need, planning, information collection & analysis, implementation of data's collected and finally development.

One that strains, a device to retain solid pieces while a liquid passes through, deposits that break Free, and other stray items in the line. The velocity of the water pushing them, they can severely damage or clog devices installed in the flow stream of the water line. A strainer is a device used to filter or remove impurities. It can also be defined as an apparatus used to retain larger pieces while smaller pieces and liquids pass through. The other names for a strainer include purifier or a sieve among others.

II. Product Information (Y-type Strainer)

One that strains, a device to retain solid pieces while a liquid passes through, deposits that break Free, and other stray items in the line. The velocity of the water pushing them, they can severely damage or clog devices installed in the flow stream of the water line. A strainer is a device used to filter or remove impurities. It can also be defined as an apparatus used to retain larger pieces while smaller pieces and liquids pass through. The other names for a strainer include purifier or a sieve among others.

Strainers come in several different styles as mentioned following based on the needs & application requirement. A plate strainer is the simplest, in which water flows through a perforated plate. Often the plate is corrugated shape to increase surface area. A Y-TYPE strainer is a design where the strainer is shaped like a English letter "Y" and usually installed in a vertical cylinder and horizontal/ vertical pipes. The Y-TYPE strainer is easier to clean, since debris is captured in the basket. It can also installed where space constraint or position concern for available space. Usually Y-Type Strainer offer less straining surface area than a plate strainer but Y-Type strainer having a greater advantage to installed vertical or horizontal position & also very quick cleaning can be done with the advantage of strainer shape of Y-TYPE. Strainer elements are generally

selected as per the application and for water /condensate application it is better to have it from stainless steel for corrosion resistance.

Types of Strainer

- A. Y-TYPE STRAINER
- B. BASKET TYPE STRAINER
- C. CONICAL TYPE STRAINER
- D. DUPLEX TYPE STRAINER

III. Research Analysis

3.1 STAGE OF NEW PRODUCT DEVELOPMENT PROCESS



1. IDEA GENERATION

Idea generation is also called the new product development process “NPD”.

- a. Ideas for new products can be obtained from basic research using a SWOT analysis (Strengths, Weaknesses, and Opportunities & Threats). Market and consumer trends, company's R&D department, competitors, focus groups, employees, salespeople, corporate spies, trade shows, or ethnographic discovery methods (searching for user patterns and habits) may also be used to get an insight into new product lines or product features.
- b. Lots of ideas are generated about the new product. Out of these ideas many are implemented. The ideas are generated in many forms. Many reasons are responsible for generation of an idea.
- c. Idea Generation or Brainstorming of new product, service, or store concepts - idea generation techniques can begin when you have done your OPPORTUNITY ANALYSIS to support your ideas in the Idea Screening Phase (shown in the next development step).

2. IDEA SCREENING

- a. Will the customer in the target market benefit from the product?
- b. What is the size and growth forecasts of the market segment / target market?
- c. What is the current or expected competitive pressure for the product idea?
- d. What are the industry sales and market trends the product idea is based on?
- e. Is it technically feasible to manufacture the product?
- f. Will the product be profitable when manufactured and delivered to the customer at the target price?

3. CONCEPT TESTING

- a. Develop the marketing and engineering details
- b. Investigate intellectual property issues and search patent databases
- c. Who is the target market and who is the decision maker in the purchasing process?
- d. What product features must the product incorporate?
- e. What benefits will the product provide?
- f. How will consumers react to the product?
- g. How will the product be produced most cost effectively?
- h. Prove feasibility through virtual computer aided rendering and rapid prototyping
- i. What will it cost to produce it?

4. BUSINESS ANALYSIS

- j. Estimate likely selling price based upon competition and customer feedback.
- k. Estimate sales volume based upon size of market.
- l. Estimate profitability and break-even point

5. TEST MARKETING

- a. Produce a physical prototype or mock-up.
- b. Test the product (and its packaging) in typical usage situations.
- c. Conduct focus group customer interviews or introduce at trade show.
- d. Make adjustments where necessary.
- e. Produce an initial run of the product and sell it in a test market area to determine customer acceptance.

6. TECHNICAL IMPLIMENTATION

- a. New program initiation.
- b. Finalize Quality management system.
- c. Resource estimation.
- d. Requirement publication.
- e. Publish technical communications such as data sheets.
- f. Engineering operations planning.
- g. Department scheduling.
- h. Supplier collaboration.
- i. Logistics plan.
- j. Resource plan publication.
- k. Program review and monitoring.
- l. Contingencies - what-if planning.

7. COMMERCIALIZATION

- a. Launch the product.
- b. Produce and place advertisements and other promotions.
- c. Fill the distribution pipeline with product.
- d. Critical path analysis is most useful at this stage.

8. REVIEW OF MARKET PERFORMACE

- a. Impact of new product on the entire product portfolio.
- b. Value Analysis (internal & external).
- c. Competition and alternative competitive technologies.
- d. Differing value segments (price, value and need).
- e. Product Costs (fixed & variable).
- f. Forecast of unit volumes, revenue, and profit.

3.2 New Product Planning and development based Concurrent Engineering Model (CE Model)

Concurrent engineering is an approach towards optimizing engineering design cycles. Because of this, concurrent engineering has been implemented in a number of companies, organizations and universities, most notably in the aerospace industry.

The basic premise for concurrent engineering revolves around two concepts. The first is the idea that all elements of a product's life-cycle, from functionality, producibility, assembly, testability, maintenance issues, environmental impact and finally disposal and recycling, should be taken into careful consideration in the early design phases.

The second concept is that the preceding design activities should all be occurring at the same time, i.e., concurrently. The idea is that the concurrent nature of these processes significantly increases productivity and product quality. This way, errors and redesigns can be discovered early in the design process when the project is still flexible. By locating and fixing these issues early, the design team can avoid what often become costly errors as the project moves to more complicated computational models and eventually into the actual manufacturing of hardware.

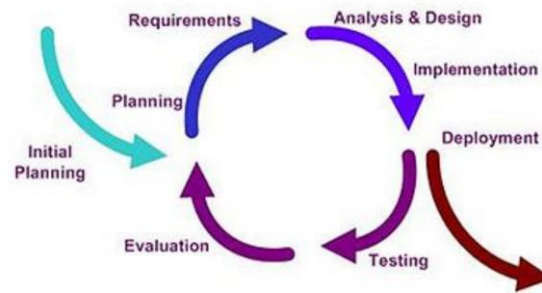
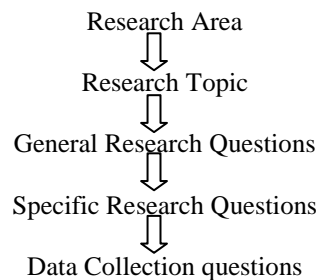


FIGURE 3.1: CONCURRENT ENGINEERING PROCESS

As mentioned above, part of the design process is to ensure that the entire product's life cycle is taken into consideration. This includes establishing user requirements, propagating early conceptual designs, running computational models, creating physical prototypes and eventually manufacturing the product. Included in the process is taking into full account funding, work force capability and time. A study in 2006 claimed that a correct implementation of the concurrent design process can save a significant amount of money, and that organizations have been moving to concurrent design for this reason.

IV. Research Method

4.0 Problem Formulation process involves following steps, which are as follows.



Here we already have our research area and topic is also known to us. General research questions and specific research questions shall be raised at every stage by stage.

Y-type strainer is the research topic and we have to design and develop the subject as per the standards and procedure.

Objective of the Study are as follows.

1. To design the new product i.e. Y-Type Strainers.
2. To development/ Manufacturing of Y-Type Strainers

4.1 Analysis work & product development

Selecting the right techniques / process to incorporate in new products is a particularly challenging aspect of new product definition and development. While newer advanced technologies may offer improved performance, they also make the product development process more risky and challenging. In this paper, we focus on the technical selection and commitment. For technical selection following process shall be followed.

1. Selection of the filtration (mesh)
2. Material Selection
3. Pressure drop calculation

1. Selection of the filtration (mesh)

Filtration Mesh is the heart of strainer system and also some selection parameters are explained. One of the most important design considerations when purchasing a strainer is specifying the perforation or mesh size of the straining element. The straining element is a mechanical filter which removes and retains particles too large to pass through yet allows the flowing media (liquid or gas) to pass unobstructed. This process is illustrated in Figure 1. By cleaning the flowing media, the straining element helps to protect expensive downstream equipment such as pumps, meters, spray nozzles, compressors, and turbines.

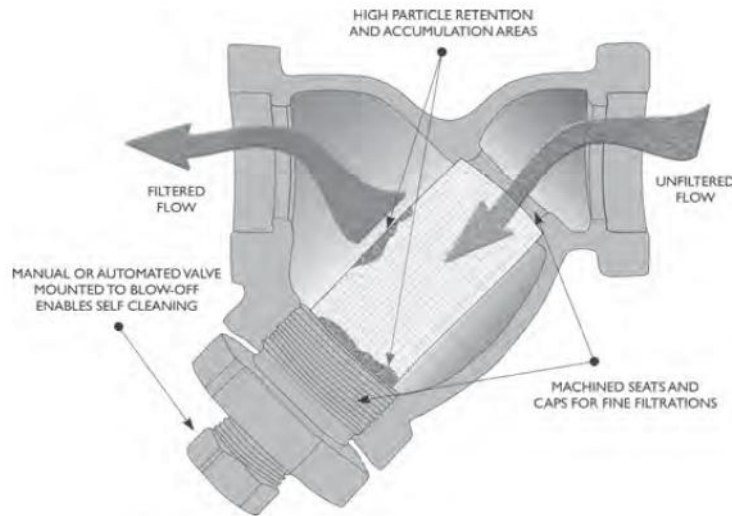


FIGURE 4.1: STRAINING ILLUSTRATION

A. Determining Opening Size:

In general, screen openings should be approximately one-half the diameter of the largest allowable particle. The largest allowable particle is defined as the size of particle that can pass through downstream equipment without causing damage. For example, if the maximum allowable particle is 1/16 inch then the screen opening would be specified at 1/32 inch. In addition to the size of particles, the quantity of debris in the flowing media must also be considered when determining the appropriate opening size. Straining elements can only be used to remove insoluble floating impurities. The most common range of particle retention is 1 inch down to 40 microns (.0015 inch). See Figure 2 for a comparison of sizes for a variety of common particles.

A common mistake is to specify a screen opening that is too small for the application. This can lead to overstraining and should be avoided for the following reasons:

- Maintenance costs are significantly increased due to excessive cleaning requirements.
- Pressure drop is increased dramatically.
- The straining element may become damaged and fail.

B. Screen Types

In general, strainer elements are available in three types: perforated, wire mesh, and reinforced wire mesh lined.

Perforated Screen: A standard perforation size suitable for general service for each type of strainer. The standard perforation size has been determined to provide the best balance of open area ratio (OAR), hole arrangement, and gauge thickness that results in the least amount of pressure drop. In general, strainer elements are available in three types: perforated, wire mesh, and reinforced wire mesh lined. Where permissible, uses a 60° staggered round hole arrangement because of its superior strength and large open area ratio (OAR). On smaller perforation sizes, Titan FCI uses a straight line, round hole pattern that allows for a large OAR yet does not compromise gauge thickness. In general, as the hole diameter becomes smaller and the OAR increases, the gauge thickness inherently becomes thinner.

Wire Mesh: For finer straining applications, down to 40 micron, wire mesh straining elements are available. Utilizes a mono-filament, plain square weave that exhibits large OAR and very low flow resistance.

Wire Mesh Lined: In most cases, wire mesh straining elements are reinforced with a heavier gauge, perforated metal backing to provide additional support. Standard perforated metal backing is 5/32 inch which provides excellent support without significantly diminishing the OAR.

V. Material Selection

The most common construction material used for straining elements is stainless steel. This is due to the inherent resistance to corrosion stainless steel provides. As such, construction material for all straining elements is Type 304 stainless steel. Other materials (316 SS and 316L) are available upon application.

Material selection is a step in the process of designing any physical object. In the context of product design, the main goal of material selection is to minimize cost while meeting product performance goals. Systematic selection of the best material for a given application begins with properties and costs of candidate materials.

As far as concerns with the Y- type strainer and application to power plant, we have considered the material as per our standard practice, we can also change the material as per the other application and client requirement. The whole basis of material selection process is directly related to following.

1. Application of the product.
2. As per the codes and Standards
3. Cost associated with the product
4. Market competition
5. Availability of materials

Blind Flange: - A blind flange is a plate for covering or closing the end of a pipe. A flange joint is a connection of pipes, where the connecting pieces have flanges by which the parts are bolted together.

Screen / Wire Mesh: - consists of semi-permeable barrier made of connected strands of metal, fiber, or other flexible/ductile material. Mesh is similar to web or net in that it has many attached or woven strands.

Connecting Flanges: - is an external or internal ridge, or rim (lip), used for strength, for attachment to another object.

Gasket: - A gasket (correct terminology is a "joint" made from "jointing material") is a mechanical seal which fills the space between two or more mating surfaces, generally to prevent leakage from or into the joined objects while under compression.

Stud / Nuts: - Used to join the flanged at both end to avoid and kind of gap.

Drain: - A drain is a fixture that provides an exit-point for waste water or water that is to be re-circulated designed as per the system requirement.

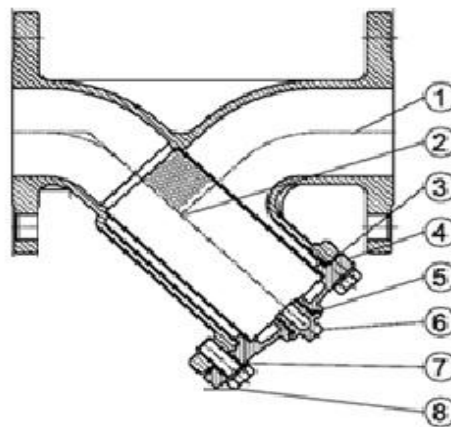


FIGURE 4.2 GENERAL ARRANGMENT OF STRAINER

S.NO.	DESCRIPTION	MATERIAL
1	BODY	SA 106 GR.B
2	SCREEN (WIRE MESH)	SS 304
3	GASKET	SPIRAL WOUND GRAPHITE
4	BONNET	SA 106 GR.B
5	GASKET	IS 2062 GR. A / B
6	STOPPER/DRAIN	CF8M
7	SPRING WAHER	SS304
8	BONNET BOLT	SS304

2. Calculations for Pressure Drop

Here we have presented a sample calculation of pressure drop across wire mesh of Strainer of 80NB diameter.

Importance of Pressure drop calculation.

1. Important for downstream equipment (e.g.: NPSHa required for pump equipment).
2. Pressure Drop \propto (Velocity)².
3. Pressure Drop \propto (1/Diameter)⁴

4. Maximum “clean” pressure drop should not exceed 0.1 bar.
5. Maximum “dirty” pressure drop across screen should not be more than 0.5 bar for a standard strainer.
6. Can be calculated or read from a pressure drop chart with considerations made for fluid, viscosity, velocity etc.
7. Pressure drop information is approximate.
8. Pressure drop calculation is useful to select the Pump head for suitable selection.
9. It is necessary for identifying the set values of other instruments like differential pressure switch installed across the strainers.
10. Frequency & nature of debris creates clogging will indicate the type of problem associated with upstream system.
11. Screen replacement at designed time interval.
12. For setting of proper Inter logics between instruments of plant.
13. If pressure drop value is more than specified then it will calls for cleaning of strainer and during this cleaning process stand by pump can be operated.
14. Mesh selection should be such that the size of particle coming to it should not larger than the gap between impeller and casing.

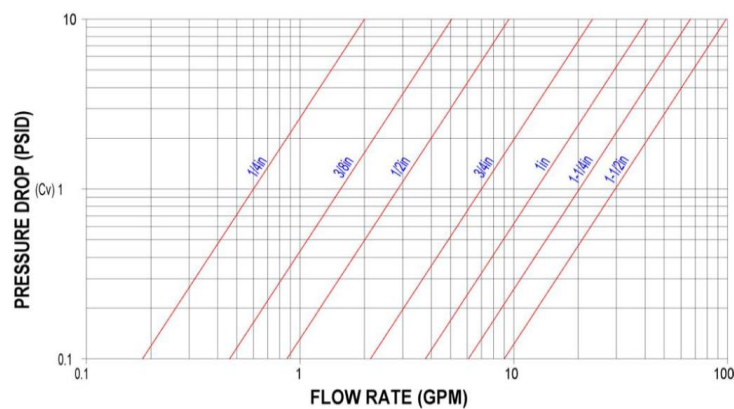


FIGURE 4.3: Y STRAINER PRESSURE DROP- LIQUID SIZE (1/4” To 1-1/2”)

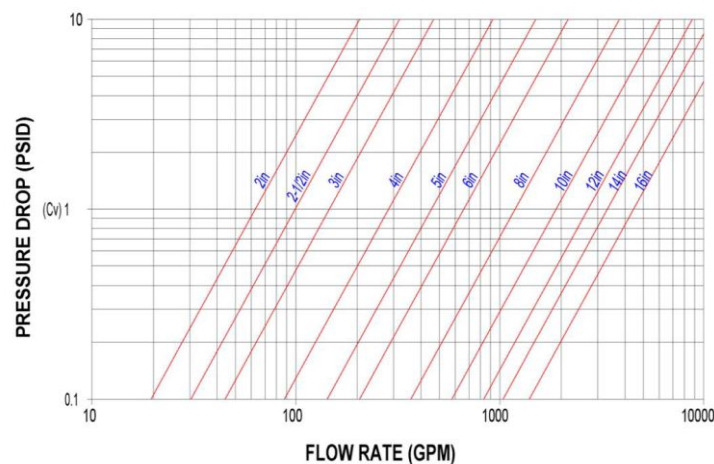


FIGURE 4.4: Y STRAINER PRESSURE DROP- LIQUID SIZE (2” To 16”)

FOR NON-STANDARD AND MESH LINED SCREENS

Multiply values obtained from Figure 1 and 2 by the appropriate values shown below

CHART 1

SIZE RANGE	SCREEN OPENINGS							
	Perforated Plate % Screen Material Open Area					Mesh Lined Standard Screens % Screen Material Open Area		
	60%	50%	40%	30%	20%	50%	40%	30%
1/4" to 1-1/2"	0.45	0.55	0.7	1	1.15	1.05	1.05	1.2
2" to 16"	0.65	0.8	1	1.4	2.15	1.05	1.05	1.2

NOTE: Standard Screen for sizes 1/4” to 1-1/2” is approximately a 30% open area screen Media
Standard Screen for sizes 2” to 16” is approximately a 40% open area screen Media

FIGURE 4.5: SCREEN CORRECETION FACTOR

CHART 2		CHART 3					
SIZE RANGE	COMPONENT FACTOR (CF)	VISCOSITY Cp	BODY LOSS FACTOR (BF)	SCREEN LOSS FACTOR			
				Perf Alone (PF)	20 mesh lined (MF)	30, 40 mesh lined (MF)	60 to 300 mesh lined (MF)
1/4" to 1-1/2"	0.25	10	1	1.15	1.3	1.4	1.5
2" to 16"	0.35	25	1.2	1.25	2	2.2	2.5
		100	1.6	1.4	3	4	6.5
		200	2.2	1.5	4.5	7	11.5
		500	4.4	1.6	10	15	25
		1000	8	1.7	15	30	50
		2000	15.2	1.9	30	60	100

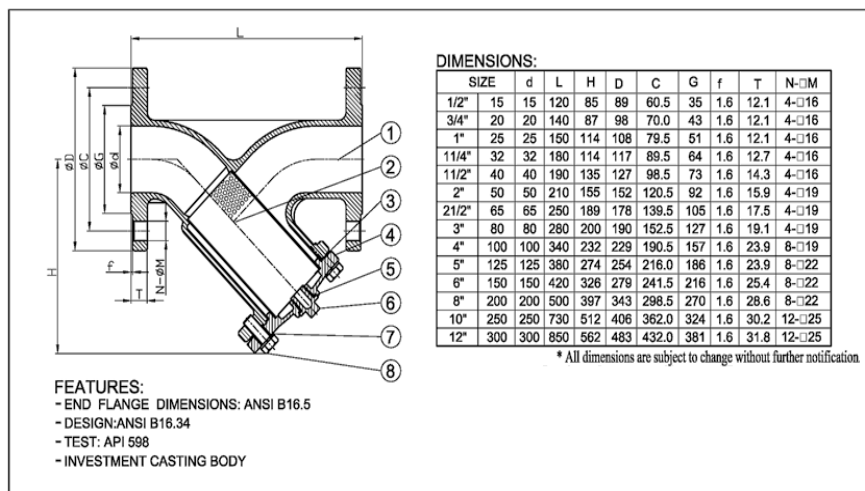
FIGURE 4.6: VISCOSITY & DENSITY FACTOR

PRESSURE DROP CALCULATION				
INPUT				
			VALUE	UNIT
1	STRAINER SIZE	A=	1-1/4	INCH
2	FILTRATION MESH LINED PERFORATED (1/34")		100	Nos.
3	FLOW RATE	F=	30	GPM
4	SERVICE		WATER	
5	Viscosity	Vs=	25	Cp
6	Specific gravity of water	Sg=	1	
STEP FOR PRESSUR DROP CALCULATION				
			Value	Unit
1	Using FIGURE 4.3 The pressure drop	P1=	1	PSID
2	Percentage open area of 100 mesh		30	%
3	Using Fig 4.5 chart 1 correction factor for 100 mesh lined		1.2	PSID
4	Total Pressure drop (A X B)	P2=	1.2	PSID
5	specific gravity Fluid flowing through strainer	P3 =SgXP2	1.2	PSID
6	Using Figure 4.6 Chart 2 determined Component factor	CF	0.25	
7	Pressure drop after using correction factor	P4=P3 X CF	0.3	PSID
8	Actual Pressure drop	P5= P3-P4	0.9	PSID
9	Using Figure 4.6 Chart 3 determined body factor	BF=	1.2	
10	Appropriate Pressure Drop	P6=P4XBF	0.36	PSID
11	Appropriate screen lose factor Using figure 4.6 chart 3	P7= P5X(PF or MF=2.5)	2.25	PSID
			2.61	PSID
12	Total pressure drop	P8=P6+P7	0.18009	bar

VI. CONCLUSION

Development phase involves the sizing of the strainer, which is done as per the Manufacturing standards and tolerance and selection of materials shall be done as per ASME B 16.5 (2009) ANSI B 36.10 and as per ASME SEC VIII (2010).

With the above sizing and calculations manufacturing of the below Y- type strainer can be done and same shall be used in process refineries and power plants for equipment safety, which are installed downstream to strainer.



Selected Materials List For Y-Type Strainer

S.NO.	DESCRIPTION	MATERIAL
1	BODY	SA 106 GR.B
2	SCREEN (WIRE MESH)	SS 304
3	GASKET	SPIRAL WOUND GRAPHITE
4	BONNET	SA 106 GR.B
5	GASKET	IS 2062 GR. A / B
6	STOPPER/DRAIN	CF8M
7	SPRING WAHER	SS304
8	BONNET BOLT	SS304

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